

What is claimed is:

1           1. A reduced size TM cylindrical shaped microstrip antenna  
2 array comprising:

3           (a) a first dielectric layer;

4           (b) a plurality of rectangular shaped antenna elements  
5 mounted on an upper surface of said first dielectric  
6 layer, said antenna elements being aligned with one  
7 another and fabricated from copper, said antenna elements  
8 being adapted to transmit RF carrier signals containing  
9 telemetry data;

10          (c) a first copper cross hatch pattern mounted on the  
11 upper surface of said first dielectric layer around a  
12 periphery for each of said antenna elements wherein a gap  
13 forms between first, second and third edges of the  
14 periphery of each of said antenna elements and said copper  
15 cross hatch pattern;

16          (d) an antenna feed network mounted on a bottom surface of  
17 said first dielectric layer for connecting each of said  
18 antenna elements to an antenna feed network input  
19 terminal, said antenna feed network including a plurality  
20 of transmission lines configured to provide for an equal  
21 transmission line length from said antenna feed network  
22 input terminal to each of said antenna elements such that  
23 the RF carrier signals transmitted by each of said antenna

elements are in phase and have equal amplitudes;

(e) a second copper cross hatch pattern mounted on the bottom surface of said first dielectric substrate in proximity to said antenna feed network;

(f) a second dielectric layer positioned below said first dielectric layer in alignment with said first dielectric layer;

(g) a third copper cross hatch pattern mounted on an upper surface of said second dielectric layer, said third copper cross hatch pattern being in alignment and substantially identical to said second cross hatch pattern; and

(h) a solid copper ground plane affixed to a bottom surface of said second dielectric layer.

2. The TM cylindrical shaped microstrip antenna array of claim 1 wherein said antenna feed network includes a main transmission line connected to said antenna feed network input terminal and a plurality of branch transmission lines, each of said branch transmission lines having one end thereof connected to one of said antenna elements and an opposite end thereof connected to said main transmission line.

3. The TM cylindrical shaped microstrip antenna array of claim 1 operates at a TM frequency band of 2210 MHz +/- 2.5

3 MHz.

1 4. The TM cylindrical shaped microstrip antenna array of  
2 claim 1 wherein said TM cylindrical shaped microstrip antenna  
3 array fits on a projectile having a diameter of five inches,  
4 said TM cylindrical shaped microstrip array having a width of  
5 1.5 inches, and a depth of 0.5 inches.

1 5. The TM cylindrical shaped microstrip antenna array of  
2 claim 1 further comprising a bonding film positioned between  
3 said first dielectric layer and said second dielectric layer,  
4 said bonding film securing the bottom surface of said first  
5 dielectric layer to the upper surface of said second dielectric  
6 layer.

1 6. The TM cylindrical shaped microstrip antenna array of  
2 claim 1 further comprising:

3 (a) a third dielectric layer positioned above said first  
4 dielectric layer in alignment with said first dielectric  
5 layer; and

6 (b) a bonding film positioned between said first  
7 dielectric layer and said third dielectric layer, said  
8 bonding film securing the upper surface of said first  
9 dielectric layer to a bottom surface of said third

10           dielectric layer.

1           7. The TM cylindrical shaped microstrip antenna array of  
2 claim 6 wherein said third dielectric layer is a cover for said  
3 TM cylindrical shaped microstrip antenna array.

1           8. The TM cylindrical shaped microstrip antenna array of  
2 claim 1 wherein said plurality of rectangular shaped antenna  
3 elements comprises six copper antenna elements mounted on an  
4 upper surface of said first dielectric layer.

1           9. The TM cylindrical shaped microstrip antenna array of  
2 claim 1 wherein said each of said plurality of antenna elements  
3 has an elongated slot located in proximity to the lower edge of  
4 said antenna element, said elongated slot in each of said  
5 plurality of antenna elements reducing the size of said antenna  
6 element, said elongated slot in each of said plurality of  
7 antenna elements having an approximate length of 0.25 of an  
8 inch.

1           10. The TM cylindrical shaped microstrip antenna array of  
2 claim 1 wherein each of said plurality of antenna elements has  
3 a step-shaped tuning tab which comprises the upper edge of each  
4 of said antenna elements, said step shaped tuning tab for each

5 of said antenna elements allowing a user to fine tune said TM  
6 cylindrical shaped microstrip antenna to an operating frequency  
7 of 2210 MHz +/- 2.5 MHz.

1 11. The TM cylindrical shaped microstrip antenna array of  
2 claim 1 further comprising a plurality of copper plated through  
3 holes positioned within said first dielectric layer and a  
4 plurality of plated through holes positioned within said second  
5 dielectric layer, the copper plated through holes of said first  
6 dielectric layer aligning with the copper plated through holes  
7 of said second dielectric layer, the copper plated through  
8 holes of said first dielectric layer being EM coupled to the  
9 copper plated through holes of said second dielectric layer,  
10 wherein the copper plated through holes of said first  
11 dielectric layer and the copper plated through holes of said  
12 second dielectric layer prevent said antenna feed network from  
13 becoming coupled to said antenna elements.

1 12. The TM cylindrical shaped microstrip antenna array of  
2 claim 11 wherein the copper plated through holes of said first  
3 dielectric layer and the copper plated through holes of said  
4 second dielectric layer each comprise 270 copper plated through  
5 holes.

1           13. The TM cylindrical shaped microstrip antenna array of  
2 claim 1 wherein each of said first, second and third copper  
3 cross hatch patterns comprises a plurality of 0.02 inch wide  
4 copper traces spaced apart by a 0.05 inch rectangular shaped  
5 opening.

1           14. A reduced size TM cylindrical shaped microstrip  
2 antenna array comprising:

3           (a) a first dielectric layer;

4           (b) six rectangular shaped antenna elements

5 mounted on an upper surface of said first dielectric  
6 layer, said six antenna elements being aligned with one  
7 another and fabricated from copper, said six antenna  
8 elements being adapted to transmit RF carrier signals  
9 containing telemetry data;

10          (c) a first copper cross hatch pattern mounted on the  
11 upper surface of said first dielectric layer around a  
12 periphery for each of said six antenna elements wherein a  
13 gap forms between first, second and third edges of the  
14 periphery of each of said six antenna elements and said  
15 copper cross hatch pattern;

16          (d) an antenna feed network mounted on a bottom surface of  
17 said first dielectric layer for connecting each of said  
18 six antenna elements to an antenna feed network input

terminal, said antenna feed network including a plurality of transmission lines configured to provide for an equal transmission line length from said antenna feed network input terminal to each of said six antenna elements such that the RF carrier signals transmitted by each of six said antenna elements are in phase and have equal amplitudes;

(e) a second copper cross hatch pattern mounted on the bottom surface of said first dielectric substrate in proximity to said antenna feed network;

(f) a second dielectric layer positioned below said first dielectric layer in alignment with said first dielectric layer;

(g) a third copper cross hatch pattern mounted on an upper surface of said second dielectric layer, said third copper cross hatch pattern being in alignment and substantially identical to said second cross hatch pattern;

(h) a solid copper ground plane affixed to a bottom surface of said second dielectric layer; and

(i) a plurality of copper plated through holes positioned within said first dielectric layer and a plurality of plated through holes positioned within said second dielectric layer, the copper plated through holes of said first dielectric layer aligning with the copper plated

43 through holes of said second dielectric layer, the copper  
44 plated through holes of said first dielectric layer being  
45 EM coupled to the copper plated through holes of said  
46 second dielectric layer, wherein the copper plated through  
47 holes of said first dielectric layer and the copper plated  
48 through holes of said second dielectric layer prevent said  
49 antenna feed network from becoming coupled to said antenna  
50 elements.

1 15. The TM cylindrical shaped microstrip antenna array of  
2 claim 14 wherein the copper plated through holes of said first  
3 dielectric layer and the copper plated through holes of said  
4 second dielectric layer each comprise 270 copper plated through  
5 holes.

1 16. The TM cylindrical shaped microstrip antenna array of  
2 claim 14 further comprising a bonding film positioned between  
3 said first dielectric layer and said second dielectric layer,  
4 said bonding film securing the bottom surface of said first  
5 dielectric layer to the upper surface of said second dielectric  
6 layer.

1 17. The TM cylindrical shaped microstrip antenna array of



2 claim 14 further comprising:

3 (a) a third dielectric layer positioned above said first  
4 dielectric layer in alignment with said first dielectric  
5 layer; and

6 (b) a bonding film positioned between said first  
7 dielectric layer and said third dielectric layer, said  
8 bonding film securing the upper surface of said first  
9 dielectric layer to a bottom surface of said third  
10 dielectric layer.

1 18. The TM cylindrical shaped microstrip antenna array of  
2 claim 14 wherein said each of said six antenna elements has an  
3 elongated slot located in proximity to the lower edge of said  
4 antenna element, said elongated slot in each of said six  
5 antenna elements reducing the size of said antenna element,  
6 said elongated slot in each of said six antenna elements having  
7 an approximate length of 0.25 of an inch.

1 19. The TM cylindrical shaped microstrip antenna array of  
2 claim 14 wherein each of said six antenna elements has  
3 a step-shaped tuning tab which comprises the upper edge of each  
4 of said antenna elements, said step shaped tuning tab for each  
5 of said six antenna elements allowing a user to fine tune said  
6 TM cylindrical shaped microstrip antenna to an operating

frequency of 2210 MHz +/- 2.5 MHz.

20. A reduced size TM cylindrical shaped microstrip antenna array comprising:

(a) a first dielectric layer;

(b) a plurality of rectangular shaped antenna elements mounted on an upper surface of said first dielectric layer, said antenna elements being aligned with one another and fabricated from copper, said antenna elements being adapted to transmit RF carrier signals containing telemetry data, wherein said each of said plurality of antenna elements has an elongated slot located in proximity to the lower edge of said antenna element, said elongated slot in each of said plurality of antenna elements reducing the size of said antenna element, said elongated slot in each of said plurality of antenna elements having an approximate length of 0.25 of an inch;

(c) a first copper cross hatch pattern mounted on the upper surface of said first dielectric layer around a periphery for each of said antenna elements wherein a gap forms between first, second and third edges of the periphery of each of said antenna elements and said copper cross hatch pattern;

(d) an antenna feed network mounted on a bottom surface of

23 said first dielectric layer for connecting each of said  
24 antenna elements to an antenna feed network input  
25 terminal, said antenna feed network including a plurality  
26 of transmission lines configured to provide for an equal  
27 transmission line length from said antenna feed network  
28 input terminal to each of said antenna elements such that  
29 the RF carrier signals transmitted by each of said antenna  
30 elements are in phase and have equal amplitudes;

31 (e) a second copper cross hatch pattern mounted on the  
32 bottom surface of said first dielectric substrate in  
33 proximity to said antenna feed network;

34 (f) a second dielectric layer positioned below said first  
35 dielectric layer in alignment with said first dielectric  
36 layer;

37 (g) a third copper cross hatch pattern mounted on an upper  
38 surface of said second dielectric layer, said third copper  
39 cross hatch pattern being in alignment and substantially  
40 identical to said second cross hatch pattern, wherein each  
41 of said first, second and third copper cross hatch  
42 patterns comprises a plurality of 0.02 inch wide copper  
43 traces spaced apart by a 0.05 inch rectangular shaped  
44 opening; and

45 (h) a solid copper ground plane affixed to a bottom  
46 surface of said second dielectric layer;

47 (i) a plurality of copper plated through holes positioned  
48 within said first dielectric layer and a plurality of  
49 plated through holes positioned within said second  
50 dielectric layer, the copper plated through holes of said  
51 first dielectric layer aligning with the copper plated  
52 through holes of said second dielectric layer, the copper  
53 plated through holes of said first dielectric layer being  
54 EM coupled to the copper plated through holes of said  
55 second dielectric layer, the copper plated through holes  
56 of said first dielectric layer and the copper plated  
57 through holes of said second dielectric layer each  
58 comprising 270 copper plated through holes, wherein the  
59 copper plated through holes of said first dielectric layer  
60 and the copper plated through holes of said second  
61 dielectric layer prevent said antenna feed network from  
62 becoming coupled to said antenna elements;

63 (j) a first bonding film positioned between said first  
64 dielectric layer and said second dielectric layer, said  
65 first bonding film securing the bottom surface of said  
66 first dielectric layer to the upper surface of said second  
67 dielectric layer;

68 (k) a third dielectric layer positioned above said first  
69 dielectric layer in alignment with said first dielectric  
70 layer; and

71           (1) a second bonding film positioned between said first  
72           dielectric layer and said third dielectric layer, said  
73           second bonding film securing the upper surface of said  
74           first dielectric layer to a bottom surface of said third  
75           dielectric layer.

1           21. The TM cylindrical shaped microstrip antenna array of  
2           claim 20 wherein each of said plurality of antenna elements has  
3           a step-shaped tuning tab which comprises the upper edge of each  
4           of said antenna elements, said step shaped tuning tab for each  
5           of said antenna elements allowing a user to fine tune said TM  
6           cylindrical shaped microstrip antenna to an operating frequency  
7           of 2210 MHz +/- 2.5 MHz.